from the outside is the same as that produced by such a current approaching it from the inside.

Various other phenomena, such as temporary reversals of the direction of rotation, successive action of the coil and iron tube, &c., &c., are recorded in the paper.

With a Selenoid.—An axial current flowing upwards from a south to a north seeking pole, produces dextro rotation at the former and lævo rotation at the latter.

With a Tubular Magnet.—These two directions are reversed at all distances between the two neutral points near the poles of the magnets, but not beyond. The phenomena, therefore, of rotation are more complex with a tubular magnet than with a selenoid. The directions of rotation produced by a vertical current outside a vertical coil or magnet are the same as those produced by it inside a coil alone.

The reversals of direction of rotation near the poles, which occur when a tubular magnet is employed, appear to be due to the inner surface of the magnet, and to the position of that surface in relation to the vertical current in the liquid. The direction of rotation and the points of reversal appear to be all independent of each other.

The action of radial currents is more simple than that of axial ones, especially near the poles of a magnet. With radial currents, either in the liquid or electrodes, there is no reversal, either at the centre of the magnet or coil, or at the poles or beyond them, or near the outside of the coil or magnet.

The experiments show the entire group of rotations produced inside and outside a vertical coil (with and without an iron core), and near its poles, by radial currents; also the group of rotations produced by vertical currents inside and outside a vertical coil and near its poles, and also those produced inside and outside and near the poles of a vertical coil with a tubular iron core, by such currents.

The experiments show in a conspicuous manner the difference of property of the interior surface of a hollow magnet and of that of a voltaic selenoid having the same kind of poles at their corresponding ends. This difference of property is well known, but is illustrated in the paper in a new way experimentally.

III. "Preliminary Report to the Solar Physics Committee on the Sun-spot Observations made at Kensington." By J. N. Lockyer. Communicated to the Royal Society at the request of the Solar Physics Committee. Received November 29, 1881.

Since the commencement of the observations, in November, 1879, of the twelve most widened lines in sun-spots, about 220 observations have

been made; the maps for the first and second hundred observations have been drawn up and the tabulation of the first hundred completed. The reductions are being carried on, and I hope shortly to be able to lay a full report upon the 200 observations before the Committee, but desire, in the mean time, to bring the present preliminary one before it.

The reduction of the first hundred observations, extending from November, 1879, to September, 1880, has yielded the following results:—

1. An immense variation, from spot to spot, is to be observed between the most widened lines seen in the first hundred observations. Change of quantity or density will not account for this variation. To investigate this point I had the individual observations of lines seen in the spectrum of iron plotted out on strips of paper, and I then tried to arrange them in order, but I could not succeed, for even when the observations were divided into six groups about half of them were left outstanding.

2. If we consider the lines of any one substance, there is as much inversion between these lines as between the lines of any two metals. By the term inversion I mean of any three lines A, B, C, that we may get A and B without C, A and C without B, B and C without A, and so on.

3. We have reason to believe, from experiments made here, that most of the lines seen in the spectrum of iron volatilised in the oxy-hydrogen blowpipe flame are amongst the most widened lines.

4. Certain lines of iron have been seen at rest, while other adjacent lines seen in the spectrum of this metal in the same field of view have shown change of wave-length.

5. The spectrum of iron in the solar spectrum is more like that of the arc than that of the spark.

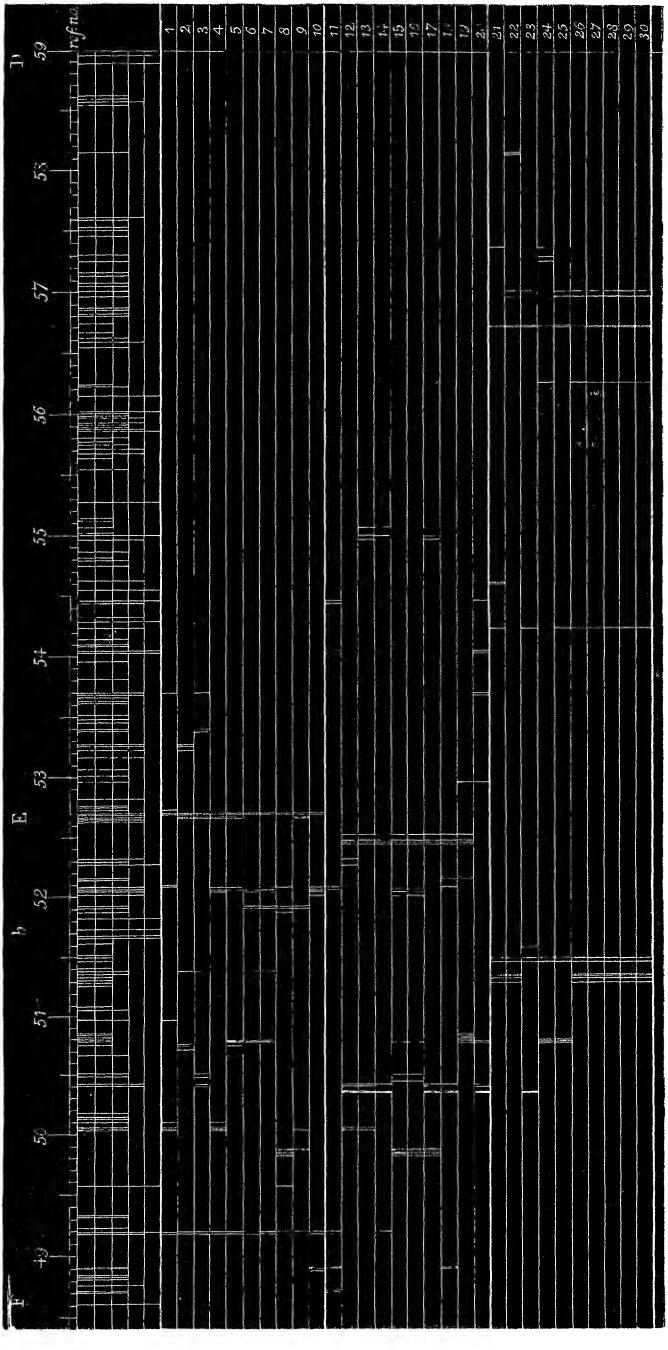
6. The greater part of the lines seen in spots and flames are common to two or more substances with the dispersion employed.

7. The first hundred spot observations being compared with a hundred observations of the spectra of flames, made by Tacchini at Palermo, have shown that there is no iron line in the region b-F common to spots and prominences.

In addition to these facts, already communicated to the Committee in more or less detail at different times, the following have been noticed in the continuation of the reductions.

8. The lines of iron, cobalt, chromium, manganese, titanium, calcium, and nickel seen in the spectra of spots and flames are usually coincident with lines in the spectra of other metals, with the dispersion employed, whilst the lines of tungsten, copper, and zinc seen in spots and storms are not coincident with lines in other spectra.

9. The lines of iron, manganese, zinc, and titanium most frequently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seen in spots are different from those most frequently seen in flames, whilst in cobalt, chromium, and calcium the lines seen in spots are the same as those seen in flames.

10. Towards the end of the first series a few lines appeared among the most widened ones which are not represented, so far as is known, among the lines seen in the spectra of terrestrial elements. This change took place when there was a marked increase in the solar activity.

So much for the results from the first series of observations.

The second series began on 29th September, 1880, and comes down to October, 1881. From a partial reduction of the observations the following results have been obtained:—

11. The number of new lines seen amongst the most widened lines has been steadily increasing. Many of these lines are very faint in the solar spectrum, and are unrecorded by Ångström, while they are wide and dark in the spot-spectrum.

12. In the months of May and June of this year (1881), there was a great change in the spectra of the spots, the old lines dying out and new lines appearing.

13. When series of observations, consisting of ten consecutive observations of the spectra of spots, taken from the commencement of the first series in November, 1879, and from the end of it on 27th September, 1880, were compared with those made towards the end of the second series on 18th July, 1881, it was found that the lines widened in each set were markedly distinct from those in the other sets.

To illustrate this, I have prepared the diagram opposite. At the top are some of the principal Fraunhoferic lines in the region F to D, the lengths representing the intensities. The lower part of the diagram is divided into three sections by strong lines; the first of these (1—10) contains the observations made between November 12, 1879, and January 20, 1880, the second (11—20) the observations made between September 27 and October 1, 1880, and the third those made between July 18 and July 29, 1881.*

* The dates of the observations and the Greenwich numberings are as follows:—

No.	Date.	Greenwich No.
1	November 12, 1879	..
2	„ 13, „	..
3	„ 14, „	..
4	„ 27, „	..
5	„ 28, „	..
6	January 3, 1880	..
7	„ 12, „	301
8	„ 19, „	306
9	„ 19, „	306

14. At the commencement of October, 1881, there was a change in the spectra of the spots similar to that which took place in May and June, but much more abrupt, for only one of the old lines remained. This is exactly analogous to the variations Tacchini saw in the spectra of the prominences in the region F to b, in December, 1872.

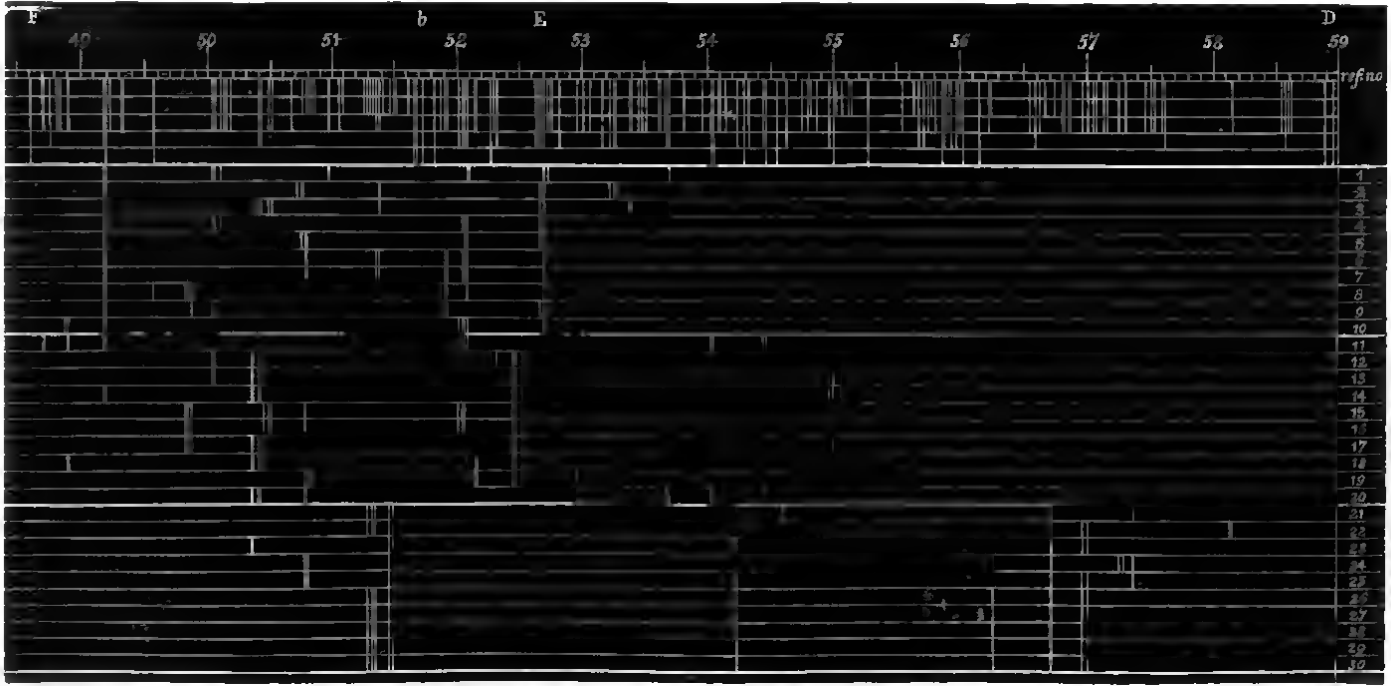
15. In the first series of observations the total number of most widened lines in the region F to b was fifty-seven, forty of which were due to iron, whilst in the second series the total number of lines seen was 104, and the iron lines faded away gradually, the last disappearing on 26th July, 1881.

16. So far as the observations have gone there has been no difference caused by the nearness of the spot to the limb.

17. At the present time more than 75 per cent. of the most widened lines are not represented in the spectra of terrestrial elements.

18. A line of titanium at wave-length 5865·0 and a line of barium at wave-length 5852·5 are amongst the recent most widened lines. Both these are long lines in the spectra of these metals. The line at wave-length 5852·5 has been seen by Young in flames, with a frequency of eight.

No.	Date.	Greenwich No.
10	January 20, 1880	306
11	September 27, „	367
12	„ 29, „	367
13	„ 29, „	368
14	„ 29, „	370
15	„ 30, „	367
16	„ 30, „	368
17	„ 30, „	370
18	October 1, „	367
19	„ 1, „	368
20	„ 1, „	370
21	July 18, 1881	..
22	„ 18, „	521
23	„ 21, „	521
24	„ 26, „	525
25	„ 26, „	529
26	„ 26, „	522
27	„ 28, „	529
28	„ 28, „	525
29	„ 28, „	527
30	„ 29, „	529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